OAR Perspective: How OAR Uses ORD's CMAQ Model

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research and development

Question

How does ORD research impact decision making and development of regulations and control strategies?

How does the ORD air quality modeling research community interact with OAR users?

Brief Description of CMAQ

ORD research has led to the latest version of the EPA's Community Multiscale Air Quality (CMAQ) modeling system, including a numerical grid model capable of simulating regional through urban patterns of ozone and photochemical oxidants, fine and coarse particulate matter, visibility, and acid deposition. The CMAQ air quality model is driven by the MM5 meteorological model and the Sparse Matrix Operator Kernel Emissions (SMOKE) model.

Model simulations can cover the entire U.S. or regional portions. Simulations can vary in length from a week to a year or more. A CMAQ one-year simulation for the continental U.S. at 36-km horizontal grid resolution can be made on a standard Linux computer cluster in less than a week. Model results are in the form of hourly gridded concentration fields of the simulated gas and particle pollutants.

Use of CMAQ Modeling in the Proposed Clean Air Interstate Rule (CAIR)

GOAL: To reduce interstate transport of secondary pollutants (SO_2 and NO_x) contributing to formation of PM2.5 through a cap and trade program for electric utilities.

- **In the development of CAIR, CMAQ was used to**:
  - **Quantify interstate PM2.5 transport** providing the basis to identify States that contribute significant amounts of PM2.5 to nonattainment in other States. These results were used to identify those States to include in the CAIR control region.
  - **Quantify the expected benefits of CAIR controls** in 2010 and 2015 in terms of reductions in PM2.5 nonattainment counties, the extent of harmful health effects of PM2.5 and acid deposition, as well as the improvements in visibility in Class I areas.

States in CAIR control region

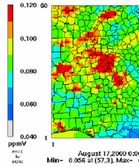
- Model runs were performed for
  - 2001 Base Year,
  - 2010 and 2015 future year baselines,
  - 2010 and 2015 CAIR control scenarios, and
  - 2010 State-by-State "zero-out" runs to quantify interstate PM2.5 contributions.
- The modeling domain for CMAQ simulations cover the continental U.S. and adjacent portions of Canada and Mexico.

Expected Results of CAIR by 2015

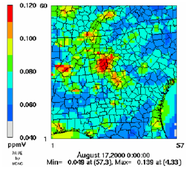
- NO_x emissions reduced 70% below current levels and SO_2 reduced 65%.
- **Based on CMAQ modeling** with the expected emissions reductions,
  - 28 additional counties attain $PM_{2.5}$ standard and
  - 8 additional counties attain 8-hour ozone standard.
- $82.4 billion in annual health benefits from reductions in fine particle and ozone concentrations.
- $1.4 billion in annual visibility improvements in Southeastern national parks and forests.

CMAQ Modeling Contributes to State Plans for NAAQS Compliance

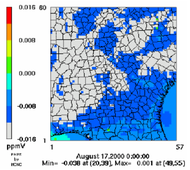
- CMAQ is used by
  - States and Tribes in PM2.5 and/or 8-hour ozone attainment demonstrations for State Implementation Plans (SIPs), and
  - Regional Planning Organizations (RPOs) in demonstrations of compliance with the Regional Haze Rule (RHR).
- Modeling will be used for the SIPs to determine compliance with the National Ambient Air Quality Standards (NAAQS) for ozone and PM2.5, and reasonable progress goals for Regional Haze.
- Modeling demonstration, ambient data analyses and other supplemental analyses will be used to corroborate the results of the attainment modeling as part of the SIP.



Daily maximum ozone prediction on August 17, 2000, one day in the Fall Line Air Quality Study at 12-km resolution.



Daily maximum ozone for the future year (August 17, 2007).



Absolute difference (reduction) in ozone between 2000 and 2007 for August 17th.

NOTE: Modeling performed by Georgia Tech with funding from the Georgia Department of Natural Resources.

- Modeling Process for SIP:
  - Run a base case episode, summer or year.
  - Conduct a model performance evaluation.
  - Project emissions to the future.
  - Apply a "relative" modeled attainment test by taking the ratio of the current/future concentrations and multiplying by the current observed design value at each monitor.
  - Determine if attainment will be reached.
  - Details of the attainment test are contained in the ozone and the PM2.5 modeling guidance documents at (http://www.epa.gov/scram001/guidance/guide/draft-final-o3.pdf) and (http://www.epa.gov/scram001/guidance/guide/draft_pm.pdf).

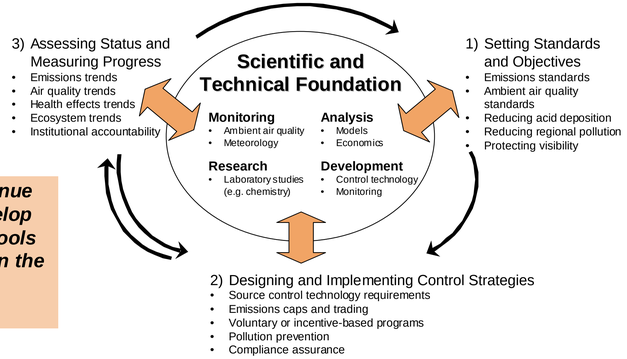
ORD and OAR will continue to work together to develop and improve modeling tools and to further strengthen the nation's air quality management system.

Interactions Between OAR and ORD Benefit Model Development

Because OAR and ORD scientists work collaboratively with the CMAQ modeling system, model development benefits from:

1. Feedback from the environmental management community's applications to **evaluate the impact of air quality management practices** for multiple pollutants at multiple scales.
2. Focusing model development efforts on those physical and chemical processes that cause major effects on the CMAQ models' **response to emission control strategies.**
3. Increased **applications** to help assess the CMAQ model's performance under a variety of atmospheric and emissions conditions.
4. Collaborations with the **Community Modeling and Analysis System (CMAS) center**, which provides user support and training to an extended global community of CMAQ model users, providing additional feedback on the performance of the modeling system in additional national and international applications. A primary focus of the CMAS center is to instill a sense of community among the users of environmental models in government, academia, research, consultants, industry, and stakeholder groups.

Future:



Air Quality